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(54) **A method of manufacturing components of a plastics enclosure**

(57) The method comprises the step of: forming a substantially flat blank (1) of plastics material with grooves (4) formed in selected positions therein by means of a moulding process. A plastics enclosure can be formed from such blanks (1) by folding one or more such blanks (1) along the lines of the grooves (3) to form components of a desired shape and assembling selected blanks (1) and/or components together to form an enclosure.

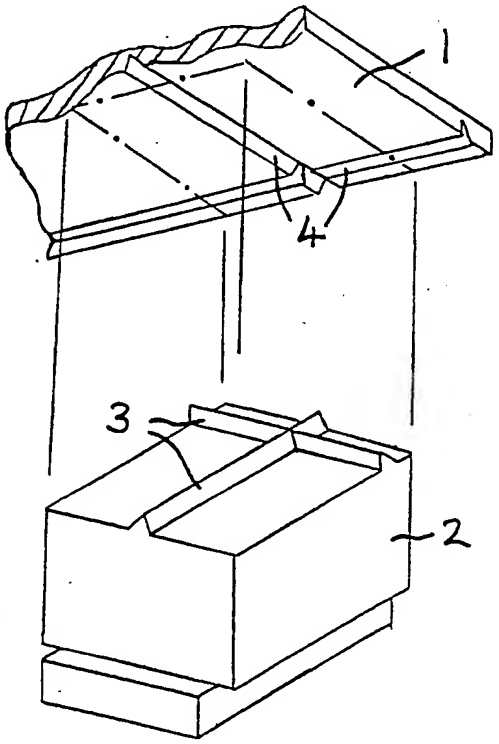

FIG. 1.

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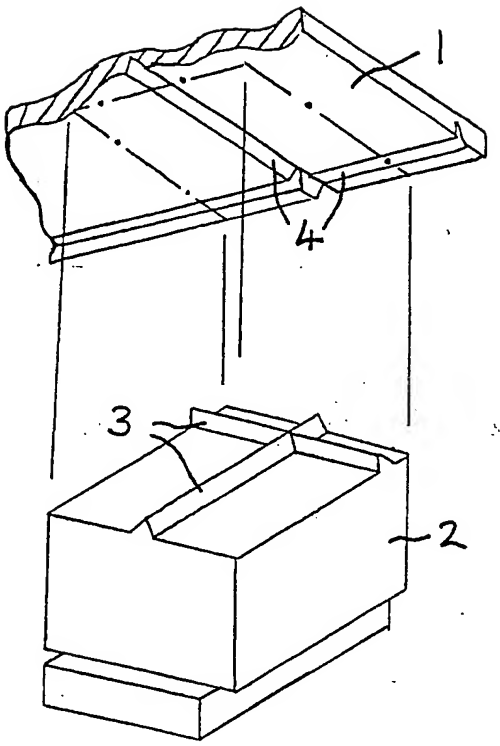


FIG. 1.

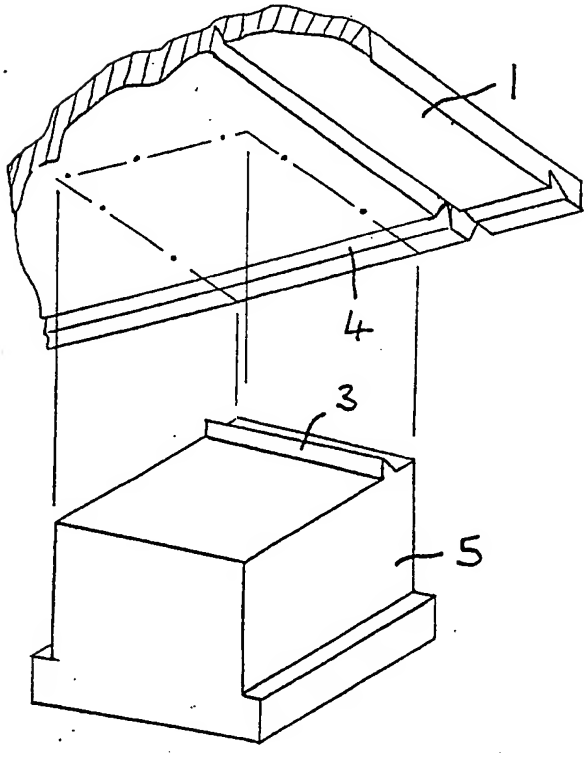


FIG. 2.

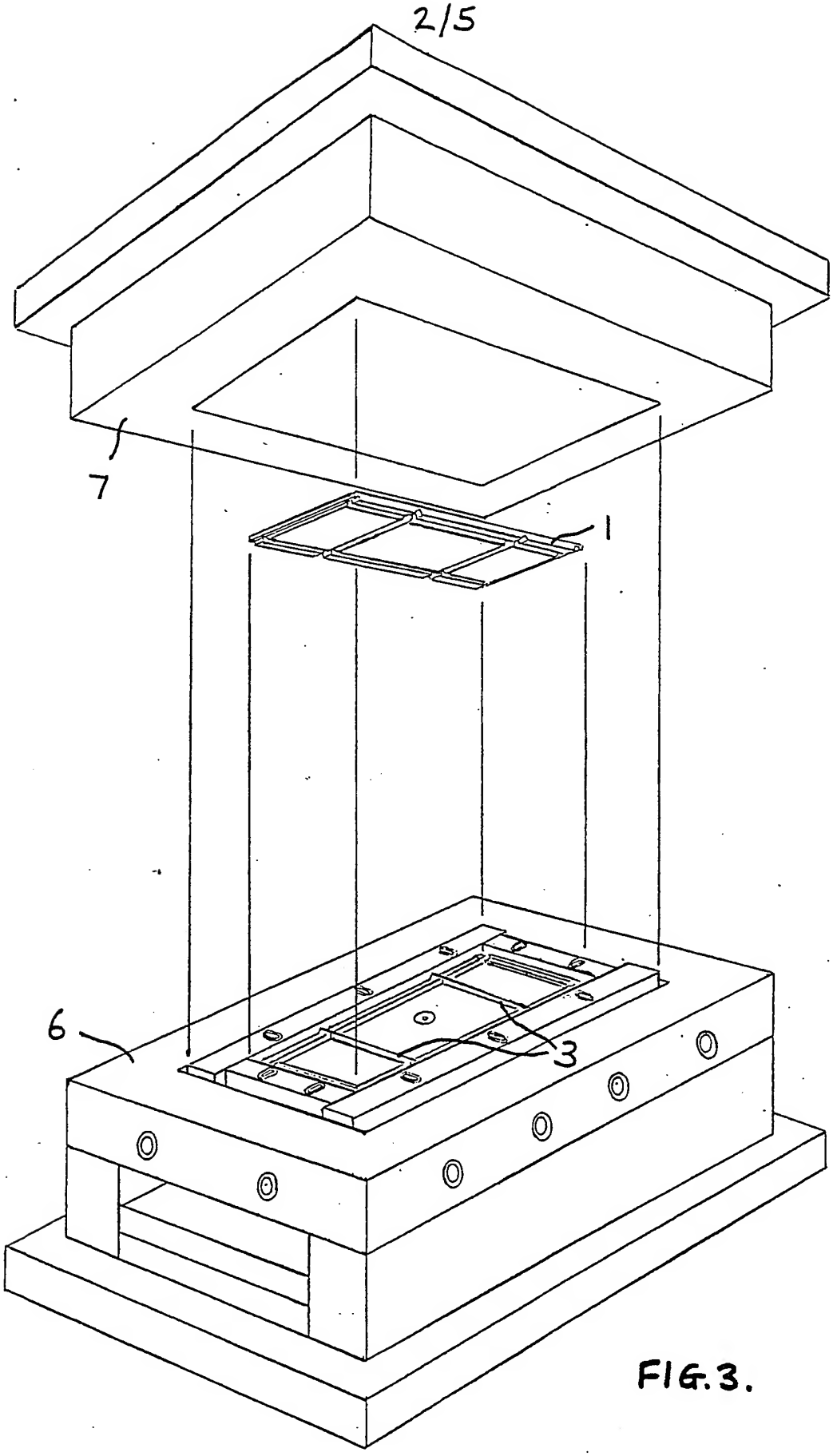


FIG. 3.

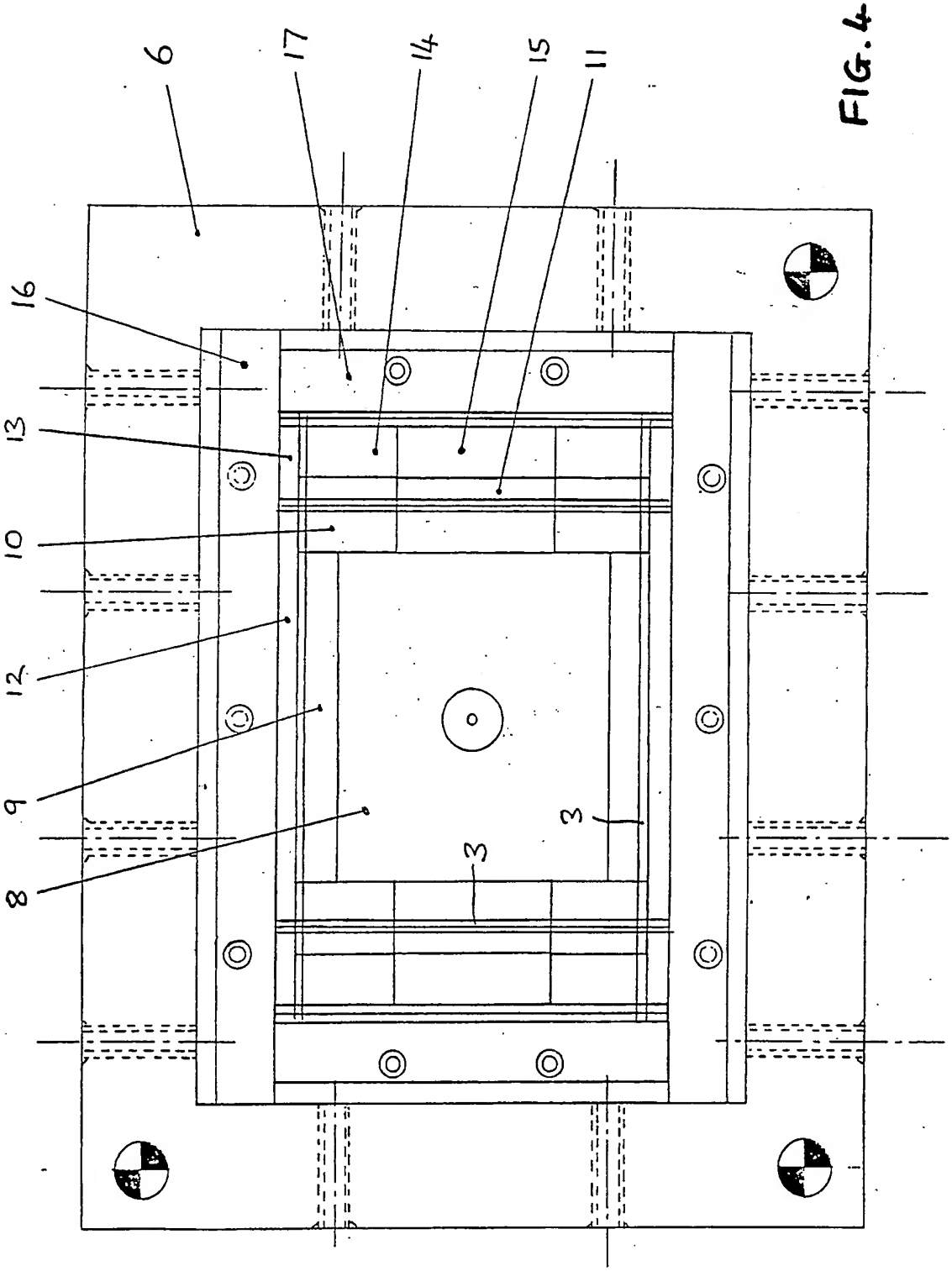
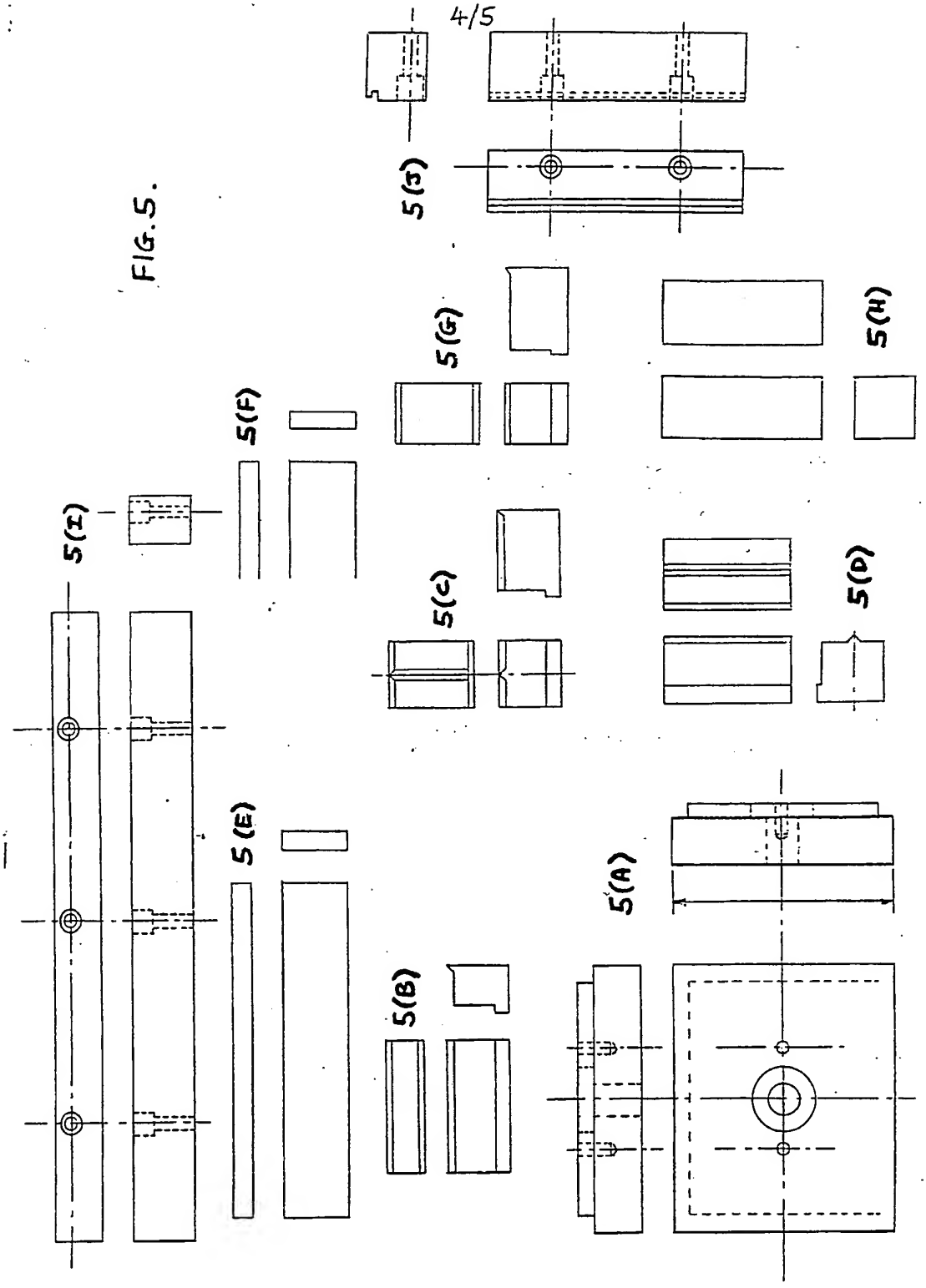


FIG. 4.

FIG. 5.



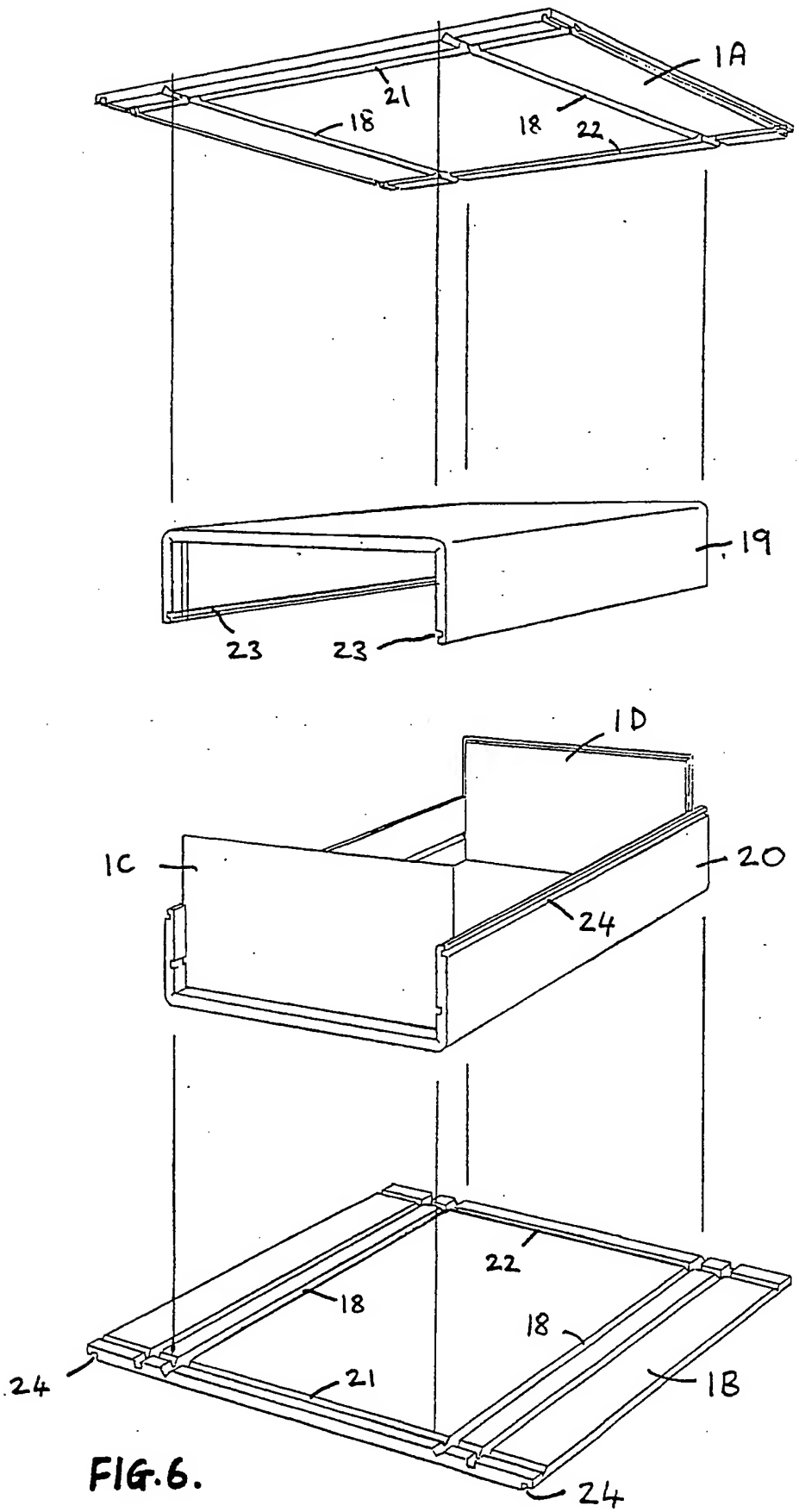


FIG.6.

METHOD OF MANUFACTURING COMPONENTS OF PLASTICS ENCLOSURES AND APPARATUS FOR USE IN THE METHOD

This invention relates to a method of manufacturing components of plastics enclosures and to apparatus for use in the method.

In the past, plastics enclosures have been manufactured by two different routes. The first route, which due to high tooling costs is limited to large production runs (e.g. in excess of 5,000), three-dimensional components are formed by injection moulding. Quite complex shapes can be formed in this way and the method is reliable and fast. The major disadvantages of this method are the very high cost of the injection moulding tool and the lack of flexibility for altering the design of the components without redesigning the injection moulding tool incurring further major expense.

The second method, which is more suitable for shorter production runs, involves the cutting and machining of large, textured plastics sheets to form substantially flat plastics blanks of the appropriate shape and size with grooves machined therein in a given pattern. The blanks are then folded along the lines of the grooves using a strip heater to form the components of the desired shape. The folded components can then be assembled together to form an enclosure. Grooves may be provided in the blanks for holding face panels and slots may be provided for receiving components such as printed circuit boards, etc. This method is used for manufacturing plastics enclosures for a wide range of electrical units such as disc drive enclosures, printed circuit containers, modem enclosures, etc.

This second method has many advantages over the injection moulding method since it includes no tooling costs and can be used for short production runs especially when short lead times are required. However, the machining operations, particularly the sawing of grooves in the sheets, is subject to inaccuracy and being labour intensive adds considerable expense to the operation. Any additonal features such as holes or slots require further machining operations.

The present invention aims to avoid the disadvantages of these known methods and to provide additional flexibility in the manufacturing process without major expense and without loss of accuracy.

According to a first aspect of the invention, there is provided a method of manufacturing a component of a plastics enclosure comprising the steps of:

forming a substantially flat blank of plastics material with grooves formed in selected positions therein by means of a moulding process.

According to a second aspect of the invention, there is provided a method of manufacturing a plastics enclosure comprising the steps of:

forming substantially flat blanks of plastics material with grooves formed in selected positions therein by means of a moulding process;

folding one or more of the blanks along the lines of the grooves to form one or more components of a desired shape; and

assembling selected blanks and/or the components together to form an enclosure.

According to a third aspect of the invention, there is provided apparatus for forming a component of a plastics enclosure by means of a moulding process comprising a moulding tool and a plurality of interchangeable inserts for the tools, the inserts being shaped to form a substantially flat blank with grooves formed in selected positions therein and being arranged such that they may be assembled together in different arrangements to form blanks of different sizes and with grooves in different positions.

Preferred features of the invention will be apparent from the following description and from the subsidiary claims of the specification.

The invention will now be further described, merely by way of example, with reference to the accompanying drawings, in which:

Figures 1 and 2 each show a perspective view of an insert for an injection moulding tool and part of a flat blank formed thereby in accordance with an embodiment of the invention;

Figure 3 is a perspective view of an injection moulding tool in accordance with an embodiment of the third aspect of the invention and shows a flat blank formed thereby;

Figure 4 is a plan view of the lower half of an injection moulding tool such as that shown in Figure 3;

Figures 5A to 5J each show plan, side and end views of inserts making up the lower half of the injection moulding tool shown in Fiugure 4; and

Figure 6 is an exploded perspective view of a typical plastics enclosure comprising components formed using a tool such as that shown in Figures 3 to 5.

Figure 1 shows part of a flat blank 1 formed by an insert 2 used in an injection moulding tool (described further below). The insert 2 is provided with raised, V-shaped ridges 3 which are designed to mould correspondingly shaped V-shaped grooves 4 in the blank 1. In this case, two grooves 4 which intersect at right angles are formed.

Figure 2 shows part of the blank 1 formed by an insert 5 having a ridge 3 for forming a straight portion of a groove 4 in the blank 1.

Inserts 2 and 5 form part of the lower half 6 of an injection moulding tool as shown in Figures 3 and 4. Figure 3 is a perspective view showing the pattern of ridges 3 made up by an assembly of inserts in the lower half 6 of the tool and shows a blank 1 with a corresponding pattern of grooves formed thereby. The upper half 7 of the tool may be provided with a further assembly of inserts for forming grooves on the other side of the blank 1 or may be flat.

Figure 4 shows a plan view of the lower half 6 of the injection moulding tool and the inserts assembled to form the required pattern of ridges 3. Figures 5A to 5J show plan, front and end views of each of the different types of insert laid out in a similar arragement for the top and right hand side of the arrangement shown in Figure 4. (N.B. the inserts are not all shown to the same scale.)

The arrangement shown in Figures 4 and 5 comprises:

a central packing insert 8 (Figure 5A)
a side V-groove insert 9 (Figure 5B)
a corner V-groove insert 10 (Figure 5C)
an end V-groove insert 11 (Figure 5D)
a side strip insert 12 (Figure 5E)
a corner strip insert 13 (Figure 5F)
a small end packing insert 14 (Figure 5G)
a large end packing insert 15 (Figure 5H)
a side packing insert 16 (Figure 5I)
an end packing insert 17 (Figure 5J)

The central packing insert 8 and the side and end packing inserts 16 and 17 are secured to the lower half 6 of the tool and the other inserts are clamped therebetween. Alternatively, the inserts may be held together by a combination of clamps, interlocking parts and screws.

Slots and holes, etc., can be easily formed in the blanks 1 by adding appropriate cores (not shown) to the injection moulding tool. Bosses and plugs can also be formed by appropriate modification of the moulding tool inserts or by using hollow cores.

As the inserts of the injection moulding tool are interchangeable, they can be quickly and easily replaced or re-arranged to form a different size blank with a different pattern of grooves.

Figure 6 shows an exploded, perspective view of an enclosure formed from plastics blanks made using an injection moulding tool of the type described

above. Top and bottom blanks 1A and 1B are first folded along the lines of grooves 18 using a strip heater (not shown) in a conventional manner to form channel shaped top and bottom components 19 and 20 of the container. End blanks or face panels 1C and 1D are then positioned in slots formed by grooves 21 and 22 and the top and bottom components 19 and 20 joined together by sliding or snapping together the mutually engageable edges formed by grooves 23 and 24.

The method of manufacturing plastics enclosures using injection moulding equipment of the type described above involves setting up the injection moulding tool with the required arrangement of inserts to form the desired pattern of grooves. Blanks of the appropriate shape and size and with the required pattern of grooves are then formed using the tool. Following this, the blanks are heated along the lines of the grooves using a strip heater and once the correct temperature is reached, folded to form channel sections. They are then assembled together to form enclosures in the same manner as conventionally formed blanks.

Forming the blanks in this manner has several advantages over the conventional machining techniques referred to above:

* The manufacture of blanks by injection moulding involves a tool setting operation followed by a machine-intensive injection moulding process so avoiding the setting errors or variations within batches which tend to occur in the conventional machining operation. Blanks can therefore be made to greater accuracy and with less variation.

* By using appropriate cores or modifying the tooling inserts, pillars, bosses and lugs can be formed during the moulding operation. In conventional machining techniques, such features would have to be formed separately and then secured to the machined blanks in a separate operation.

* Slots, recesses and under-cuts can also be easily formed during the moulding operation by adding cores to the injection moulding tool so avoiding the need for additional machining operations.

* Significant cost savings can be made by purchasing the plastics material in its raw (granular) state rather than in sheet form and by avoiding labour intensive operations such as sawing and machining. Further cost savings are made by a reduction in waste material such as machine off-cuts and the swarf generated by sawing and machining operations.

* The use of plastics material in its raw state allows greater flexibility in the choice of material type and colour than when ready-made plastics sheets are used, as granular plastics material is usually available in a wider range of types and colours and also in smaller quantities than ready-made sheets.

* The process is flexible and is cost-effective for both large (1,000-10,000) and short (50 or less) production runs due to the use of an injection moulding technique whilst avoiding high tooling costs.

The use of the injection moulding technique described above for forming plastics blanks also has advantages over the conventional injection moulding methods:

* Injection moulding flat blanks and then folding not only provides lower piece part costs, but also greater flexibility in the formation of bosses, slots and recesses. In many cases, the need for complex cores in the mould tool, which add cost and wear to the mould, can be avoided.

* Using an injection moulding tool made up of a plurality of inserts provides greater flexibility in the design of the blanks, avoids the expense of having special moulding tools made and allows alterations to be made to the design of the blank quickly and inexpensively.

* A wide range of different blanks can be made from a relatively small number of machine tool inserts by designing the inserts so each relates to a simple component of the blank, e.g. a single straight groove, an intersection of grooves, a flat area, etc., and having a range of sizes so complex patterns can be easily and quickly assembled using the appropriate arrangement of inserts.

* Due to this method of assembly, an injection moulding tool can be quickly constructed allowing very short lead times and the ability to carry out short (e.g. 50 plus) manufacturing runs economically.

The grooves formed in the blanks may have different profiles depending on their purpose. Grooves for forming fold lines may, for instance, have V-shaped or saw tooth-shaped profiles whereas grooves for receiving other components or joining components together may have a square or rectangular profile.

The method of manufacturing plastics blanks described above forms the blank and the required grooves, etc., in one moulding operation without the need for any machining operations. The injection moulding tool is made up of a number of interchangeable parts so the high cost of customised tooling is also avoided. The manufacture of enclosures using blanks formed in this way thus makes use of the advantages of the known method of manufacturing enclosures from machined blanks and the advantages of known injection moulding techniques whilst at the same time avoiding the disadvantages of both these prior art processes.

CLAIMS

1. A method of manufacturing a component of a plastics enclosure comprising the step of:

forming a substantially flat blank of plastics material with grooves formed in selected positions therein by means of a moulding process.

2. A method as claimed in claim 1 in which the blank is folded along the lines of the grooves to form a component of a desired shape.

3. A method as claimed in claim 1 or 2 in which a core is used in the moulding process to form a hole, slot or recess in the flat blank.

4. A method as claimed in claims 1, 2 or 3 in which a hollow core is used in the moulding process to form a boss, lug or pillar on the flat blank.

5. A method of manufacturing a plastics enclosure comprising the steps of:

forming substantially flat blanks of plastics material with grooves formed in selected positions therein by means of a moulding process;

folding one or more of the blanks along the lines of the grooves to form one or more components of a desired shape; and

assembling selected blanks and/or components together to form an enclosure.

6. A method as claimed in claim 5 in which at least one rectangular blank is formed with a pair of parallel grooves therein and a further groove extending across the parallel grooves, the blank is

then folded along the parallel grooves to form a channel-shaped component and a further component is assembled into the slot thus formed by the said further groove.

7. A method as claimed in claims 5 or 6 in which two rectangular blanks are formed each with a pair of parallel grooves in one side thereof and at least one with grooves adjacent opposite edges thereof in the other side, the blanks are each folded along the parallel grooves to form two channel-shaped components and these are then assembled together to form a tubular enclosure by engagement of the edges of one component with the grooves adjacent the edges of the other component.

8. A method as claimed in any preceding claim in which the blanks are formed by an injection moulding process.

9. A method of manufacturing a component of a plastics enclosure or an enclosure comprising such components substantially as hereinbefore described with reference to the accompanying drawings.

10. Apparatus for forming a component of a plastics enclosure by means of a moulding process comprising a moulding tool and a plurality of interchangeable inserts for the tool, the inserts being shaped to form a substantially flat blank with grooves formed in selected positions therein and being arranged such that they may be assembled together in different arrangements to form blanks of different sizes and with grooves in different positions.

11. Apparatus as claimed in claim 10 in which at least some of the inserts are provided with a ridge, e.g. having a V-shaped profile, facing into the mould for forming the said grooves.

12. Apparatus as claimed in claim 11 in which the plurality of interchangeable inserts comprises inserts for forming straight sections of a groove, inserts for forming an intersection between two grooves and inserts for forming a flat area of the blank

without grooves, whereby the inserts may be assembled in the moulding tool in different arrangements to form blanks having different patterns of grooves formed therein.

13. Apparatus as claimed in claims 10, 11 or 12 in which the inserts may be positioned around a central packing insert secured to the moulding tool so as to be clamped between the central packing insert and further packing inserts secured to the periphery of the tool.

14. Apparatus claimed in any of claims 10 to 13 comprising cores for positioning in the mould to form holes, slots or recesses in the flat blank.

15. Apparatus as claimed in any of claims 10 to 14 comprising hollow cores for positioning in the mould to form bosses, lugs or pillars in the flat blank.

16. Apparatus for forming a component of a plastics enclosure by means of a moulding process substantially as hereinbefore described with reference to the accompanying drawings.

17. A method of manufacturing a component of a plastics enclosure using apparatus as claimed in any of claims 10 to 16 comprising the steps of:

assembling selected inserts into the moulding tool to form a flat blank of the desired shape and with the desired pattern of grooves formed therein; and

forming a flat blank by means of a moulding process using the said tool.

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